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Near-IR/optical monitoring programme of the 'Arecibo sample of OH/IR stars'

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Abstract.
We performed a near-IR/optical monitoring programme from 1999 to 2005 in order to study the variability properties of the 'Arecibo sample of OH/IR stars' (periods, amplitudes, and colour variations). Here we describe this multi-wavelength long-term monitoring programme. Data analysis is still in process. Our ultimate goal is to study in particular the oxygen-rich AGB stars with $M > 2\,M_{\odot}$, which are probably rare among AGB stars discovered optically and/or in the near-IR, but are common in samples discovered in the mid- to far-IR.

1. The Monitoring Programme

Variability properties of AGB stars are still not well known, specially those of heavily obscured OH/IR stars. A recent study has shown a diversity of variability properties in OH/IR stars (Jiménez-Esteban et al. 2006). The number of OH/IR stars studied for variability is still very low compared to the number of Mira variables monitored, and neither the upper limit of the period distribution on the AGB nor the relation between period and other parameters (amplitude, colour, luminosity) are not well defined yet. In addition, the sequence of colours predicted for oxygen-rich AGB stars with increasing mass-loss (Bedijn 1987) is a combination of both evolution and initial mass effects (Jiménez-Esteban et al. 2005b). Variability properties may be the clue for distinguishing between both effects.

The so-called 'Arecibo sample of OH/IR stars' is the best sample available to perform this analysis (See Jiménez-Esteban et al. (2005a) for details about this sample).

We performed a 6 years near-IR (JHK) monitoring programme. In total, we used 156 observing nights distributed in 16 runs at the Calar Alto 1.2 m telescope (MAGIC) in 1999 – 2002, Calar Alto 2.2 m telescope (MAGIC) and Tenerife Carlos Sánchez telescope (CAIN-II) in 2003 – 2004, and Calar Alto Spanish 1.5 m telescope (MAGIC) in 2003 – 2005. A subsample of 51 optically bright sources was also monitored at the optical wavelength (Johnson R) at Hamburg Oscar-Lühning-Telescope (CCD) in 2001 – 2004.

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2. Preliminary Results

We collected in total ∼100,000 images which made a high level of automation desirable. Thus, semi-automated procedures were developed combining self-written IDL routines with pre-existing routines within other software packages (IRAF, SEXtractor) to perform the data reduction and generate one catalogue per individual observation including the accurate position and aperture photometry of all point-like sources detected ($> 3\,\sigma$) in the field. Afterwards, absolute and relative flux calibration was performed on every catalogue generated. Finally, the photometric data corresponding to the Arecibo sources were compiled and different epoch measurements were put together to build up the corresponding light curves from which we derive the variability properties of each source in the sample. The results of all these semi-automated procedures are currently being controlled manually to ensure high reliability on the final products.

$11-15$ photometry points were obtained for each source in the near-IR, and ~ 20 for the optical monitoring. Typical photometric accuracy was $< 0.2^m$. We have automatically fitted sinusoidal light curves to the preliminary data and obtained variability information for 375 OH/IR stars (333 for the first time). Light curve fits have failed for 57 sources, and for the rest (276) new periods and amplitudes (255 near-IR, 51 optical) have been determined. A typical period of $1.3\,^{yr}$ was found, with a long tail up to $\sim 6\,^{yr}$ (Fig.1). $< 5\%$ of the sample are non-variable or semiregulars.

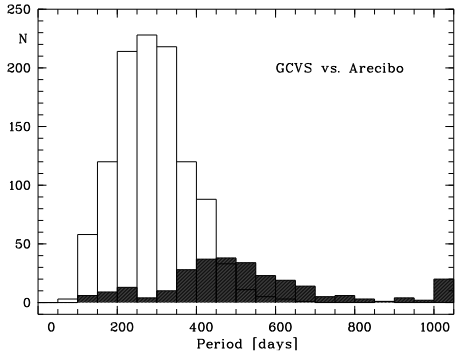

Figure 1. Preliminary period distribution of the Arecibo sources (shaded) compared to the distribution of the optical Mira variable sample included in the GCVS catalogue (Kharchenko et al. 2002).

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